

IX. *The life-history of Atypus piceus*, Sulz.

By FREDC. ENOCK.

[Read May 6th and June 3rd, 1885.]

DURING the year 1875 I read that most charming book by the late T. Moggridge, entitled 'Harvesting Ants and Trap-door Spiders,' in which is just mentioned the fact that "there is but one British or North European representative of the *Territelariæ*." I determined to search for this, but the information given in Blackwall's 'Spiders of Great Britain' was so small that I scarcely knew how or where to begin my search; however, I obtained the 'Supplement to Harvesting Ants and Trap-door Spiders,' and therein I read Mr. Brown's account of his discovery of this grand spider at Hastings, in which he states:—"My attention was first arrested by the sight of something hanging down which looked like the cocoon of some moth." With this clue I started early in 1876 to search the banks at the sides of such lanes as remained around the North of London,—at Tottenham, Edmonton, working round towards Hendon, then to Hampstead,—which seemed to be the most likely place where I might see the "something hanging down which looked like the cocoon of some moth"; but after many long and weary back-aching searches I began to think I should not be successful; and on March 26th, 1876, I had but a small part of the Heath left unworked, this composed of steepish banks, with stunted gorse and broom bushes scattered about. I searched the ground most carefully, and much to the amusement of the keepers and policemen, who seemed to doubt my sanity, my constant reply to their questions being "I am looking for *spiders*"; and I found that my movements were watched, particularly when I was searching at night. They had heard of "butterfly catching," but never before of anyone wanting *spiders*: however, I managed to allay their doubts and fears,

going on with my nose and eyes almost close to the ground, looking under tufts of grass at the base of various bushes, until at last my attention was suddenly arrested, for there was "the something hanging down which looked like the cocoon of some moth." But now a fresh difficulty arose; Hampstead Heath was "preserved," and I thought that possibly I might get myself into a "pickle" by "disturbing the soil." So I went to the superintendent, and told him I had found the spiders, and wanted to dig them up, and, as I was by this time pretty well known to him, he soon gave me permission to dig up my precious find. This I did after repeated failures, the tubes being so delicate; and I was repeatedly interrupted in my work by the usual Hampstead rambblers, who are, to say the least, inquisitive. After many trials I managed to box seven tubes, each containing a female *Atypus*.

Some of these I forwarded to Rev. O. P. Cambridge for identification: he replied "that he was not able to identify them positively unless he saw the mature male," but thought it might prove to be *Atypus Beckii*, as the late Richard Beck used to work Hampstead for spiders.

I now had my work cut out, for my only directions were:—"You might find them (the males) from October to spring, I think, so far as I know; they are never found in a tube, but are wanderers, taking shelter by day in any holes or corners, and among stones, *débris*, &c." I must confess I did not see why the male should not form a tube as well as the female, for, until it reached maturity, it certainly would require a home of its own.

In going over the ground at Hampstead I soon found that the colony of *Atypi* was much larger than I at first imagined; but, like all so-called "rarities," they only wanted looking for. I found the nests in the most awkward places to get at—numbers just at the foot of an old gorse bush, which I might not pull up to enable me to get at them; others concealed by stunted bushes of wild sage, the tube going down between the roots, and often just when I had reached to within an inch of the end, my digger would catch an unlucky bit of root, causing the tube to break short off, the spider escaping by retiring by the back door, a habit they are particularly fond of.

I searched high and low for the male among dead leaves and grass, under stones, both by day and by night, even going so far as to fancy I might possibly trap them by placing long glass phials in the ground (the mouths just level with the surface), close to the tubes of the females; but only a "devil's coach-horse" beetle, *Ocypus olens*, was stupid enough to fall in. I made many unsuccessful journeys in search of the mature male, but at the same time I added very much to my knowledge in several points connected with *Atypus*.

On October 20th, 1877, I made my twenty-ninth visit to the colony, examining a great many tubes, noting any change in their outward appearance, &c. I had almost reached my last tube when I came upon one near a stunted sage plant, having an opening at the end *with the edges turned in*, showing that something had entered. I felt sure that I was now on the right scent, and, going down on my knees in a moment, with my knife I cut away every bit of dry stalk of sage and grass; then quietly scraped away the sand from around the top, keeping hold of the aerial part of the tube, with the bent file working round it, gently raising small quantities of sand, each time going deeper, until I had uncovered about seven inches of the tube. After another ten minutes' digging the bottom of the tube was reached; my digger placed under, and the whole nest heaved out. I then noticed something moving up inside; this was the female, which soon forced its way out at the open end. I then observed at the other end something which looked like an old skin. I touched it, when it immediately spread its legs, betraying itself to be the long-sought-for *mature male*. I cannot describe my feelings or my movements at that moment. I only know I was highly excited, and immediately ran to the Highgate Post Office, and sent a post-card to the Rev. O. P. Cambridge, apprising him of my success. On the 22nd I sent this male on to him, receiving a reply which somewhat disappointed me, *viz.*, that the male was not *A. Beckii*, but *piccus*.

However, having now settled the identity of the Hampstead *Atypus*, I determined to follow up my observations, until I had completed its life-history; and I venture to think that the following facts will prove

that this representative of the marvellous trap-door spiders is well worthy of the relationship.

In Blackwall's 'Spiders of Great Britain and Ireland,' p. 15, I find it stated that the female *Atypus* deposits between thirty and forty eggs, &c., but, so far as my experience goes, this is considerably under the number, for whenever I have dug a tube containing young I always made a point of carefully counting them. My first capture was made October 29th, 1876, at night; I dug up a large tube containing a female and 129 young. February 31st, 1877, female and 157 young; this tube was nearly eleven inches long. September 25th, 1877, a female and 143 young; besides a great many other family tubes, in every one of which there were over 100 young.

On August 1st, 1877, I dug up a tube, ten inches long (example), from half to five-eighths of an inch in diameter for about six inches and a half down then widening out into a sort of pouch, containing something hard, which I at first imagined was a male. I carefully cut a slit across the tube, enabling me to see that it was the cocoon of eggs suspended in a beautiful hammock of silk, one inch long, the flat ends of which were about three-sixteenths wide, attached to the top and bottom of the pouch. I also found another tube the same date, containing an unfinished cocoon of eggs. Sept. 1st, 1879, another, which I carefully replaced.

Sept. 25th, 1879, a short tube containing female and young; these latter were quite white, evidently only just hatched, many of them being very feeble and scarcely awake. I dug another tube, in which the young seemed to be a few days older.

The following are a few of the dates when I found tubes with female and young:—Sept. 13th, 1881; Sept. 25th, 1877; Sept. 26th, 1879; Oct. 3rd, 1884; Oct. 6th, 1879; Oct. 6th, 1883; Oct. 29th, 1876; Nov. 1st, 1877; March 31st, 1877; and April 5th, 1879. I consider the last two rather late, but I find that we had wet weather in March, 1877, and a heavy fall of snow March 25th, 1879; no doubt keeping the young back.

April 2nd, 1876, I found a number of young *Atypi* wandering about on some wild sage, their silken threads crossing and recrossing from twig to twig. They were passing along these threads; all seemed inclined to get

as high as possible. I boxed a few, which I examined under my microscope, when I noticed a peculiar movement apparently in or under the eyes, but could not arrive at any satisfactory conclusion as to the cause, and the spiders soon died.

On Sept. 13th, 1881, I dug up a tube containing a female and young, a number of which had only just gone through their *first* moult, the cast-skins in the tube testifying to this fact.

Finding the young *Atypi* wandering about on the wild sage, on April 2nd, 1876, somewhat puzzled me; so I wrote to Rev. O. P. Cambridge, informing him of the fact. He replied:—"This, if a usual mode of putting their families out, would be, so far as I know, quite a new fact in their history; and, if usual, you would be sure to find them again so placed." I have carefully searched for them, but only once have I found one (April 20th, 1877), almost at the exact spot where I found the others.

I was much puzzled as to the length of time which elapses, from the entry of the male into the nest of the female, to when the young made their appearance. My idea was that eighteen months would prove to be about the time, and, though I searched year after year for proof, I did not ascertain until the present year (1885); but now I am able to place it beyond a doubt.

On Oct. 15th, 1883, I dug up at Woking (where I have found four very large colonies) five tubes, each containing a male and female. I removed the males and reset the five tubes (containing the impregnated females) in a bank at the bottom of my garden; this bank I made of turves from the Common, arranging it with great care, so that it should resemble their natural habitat as much as possible, facing S.W. To each of these five tubes I placed a good-sized wooden peg, with the number painted on, so that there should not be any chance of it washing out. These five and many others have been under almost daily notice ever since, being a constant source of interest during the spring and summer of 1884.

On March 28th, 1885, the sun was very hot, shining full upon my bank. I noticed the tubes (about thirty), which during the winter had been nearly flat to the bank, were showing signs of "spring cleaning," and the

following day, in each of the five tubes containing the impregnated females put into this bank October 15th, 1883, I observed a small round hole, one-sixteenth inch diameter, just at the apex of the aërial portion (example). I had waited so long that now, when I saw what I believed would prove a realisation of my idea, I could not rest long away from my bank; but nothing appeared that day. The following morning (March 30th) was warm and muggy, or what the country-folks call "a blight." Whilst watching these tubes, at 10 a.m., I observed a young *Atypus* emerge from the small hole in No. 5; it was shortly followed by others, until ten had left the home of their birth, *never more to return*. A few emerged from the tubes Nos. 1 and 3. The following are my notes taken on the spot:—The first young *Atypus* emerged at 10 a.m. from the hole in No. 5, walked a short distance to the foot of a grass-stem, up which it crawled, leaving its silken thread as it went along; when this one had climbed about an inch high, another young one came out, taking hold of the silken cord, followed on adding his cord to it, and so on each one following the leader, which had, by the time the tenth one emerged, mounted up several inches, and, climbing up a small twig, it would descend again to the main stem, up which it climbed, bridging over the space from twig to twig with the never-ending silken cord, along which each one followed, strengthening it as they passed, until it became quite visible, glistening in the sun.

The young *Atypi* still went on mounting higher and higher: "Excelsior" was evidently their motto. I had previously stuck some pea-sticks on the top of the bank just above these tubes, and the first spider was not such a great while in reaching one, up which it crawled, followed by the others. The first arrived at the top (some 3 ft. 6 in. from the ground), walked round and round, the others soon joined it, and not one of the ten seemed inclined to descend by the same way they came up; the rising wind gently swayed the sticks about, until some of the spiders were blown off into mid-air, still keeping a hold upon their endless silken cords, until they became attached to other sticks; these they mounted as the first, were again blown off on to the grass, at 5 p.m., where they hid themselves, no doubt

taking lodgings therein for the night, during which we had a sharp frost of six degrees.

The next morning *all* the small outlets in the tubes were carefully spun up, and, judging from the "mesh" of the web, I should say the female had, with a mother's care, closed the opening so securely that the remaining members of her family could not make their *débüt* until more favourable weather.

Another tube with female and young, taken Oct. 15th, 1883, I put into a large flower-pot of sand, which I placed in a conservatory. March 16th, 1884, an exceedingly hot day, I found the young *Atypi* crawling all about some geraniums, over and around which they had made a regular sort of silken trellis by their crossing and recrossing. Nearly all had disappeared by next morning. I was called away, and prevented from securing any of them, but noticed that two had found their way into a large bell-glass nearly filled with sand, already containing two tubes with females.

On October 4th, 1884, I dug up a tube containing a female and young, which I immediately reset in a large flower-pot with sand up to within an inch and a half of the top. This I placed in a warm room, where I could examine it at any time. On the 7th the aerial part was much inflated; the 9th, the female evidently enlarging her premises, the heap of sand lying at the end, giving me good evidence that she had added about one inch in depth to her tube. No doubt the warmth of the room brought on the young somewhat earlier than usual, for on January 30th, 1885, I noticed a small round hole at the top of the tube. The next day (Jan. 31st) I observed seven young ones crawling round and round the inside edge of the pot under the glass cover; Feb. 1st, fifteen; the 2nd, thirty-one; and the 3rd, fifty-four. These continued their peregrinations during the whole of the day, forming a perfect tunnel of silk, attached to the cover and edge of the pot. I noticed that they could easily force their way through the silken walls when pressed too hard by their followers.

Feb. 4th was a very fine day; I placed the pot out in the sun. I was called away from home that day, and the spiders were left out all the night, which was a very wet one, followed by a sharp frost. On looking for them next day not one was to be seen; but, on closer examin-

ation, I found they had descended from their aërial tunnel to the angle formed by the sand and side of the pot, where they had formed several horizontal tunnels, covered over with sand; but how this was done had long been a mystery to me, and to endeavour to solve it I thought that possibly the tube was at first viscid, the female forcing the excavated sand out at the top, which, falling down, adhered to the silk, for I could hardly believe that the spider came out and covered the outside with sand, &c.; but to prove this, I reset a large female in a pot, leaving the end of the tube just level with the ground; I covered this with the lid of a small pill-box the same size as the tube, then I covered the surrounding sand with a layer of bright red brick-dust, and carefully removed the lid, leaving the tube quite clean. During the next night the female lengthened her tube three-quarters of an inch; and this was covered with *black* sand, proving that it was done from the *inside*. But yet this did not satisfy me as to *how* the sand was affixed: however, the accident of leaving the pot containing the young out all night was the means of clearing up the mystery to my entire satisfaction, besides enabling me to watch the young *Atypus* commence life on its own account, by laying the foundations of its future home.

Shortly after I had brought the pot back to my room the warmth caused all the *Atypi* to come out of their sandy tunnel, and ascend to their aërial one. I then took the pot out again into the cold, which had the desired effect upon them, for they quickly descended to the sand, evidently determined to select suitable sites for their dwellings; most of them entered the various tunnels in the sand from which they had escaped but an hour or two before, the rest walking round and round, carefully examining any irregularity or small depression in the sand. Two of them were much interested in a minute piece of sandstone standing up at the side of the pot, and one, after coming into contact with it three or four times, appeared to finally settle that this bit of sandstone would form a very good support for the end of its tube, for it commenced moving its spinners from it to the inside of the pot, and towards the tiny corner formed by this sandstone. After weaving a silken carpet of about a quarter of an inch long by one-eighth of an

inch wide, it commenced twisting its abdomen up and over from side to side, each time fixing the ends of the silk to the sandstone and floor, gradually moving up towards the side of the pot, to which it fixed some silken cords, but not so thickly as at the lower end; it continued this twisting movement until it had roofed itself in, thus forming an upright tube a quarter of an inch long and fully one-sixteenth wide. The end fixed to the pot was turned up very slightly, the other to the sandstone and level of sand-line. The time occupied was just one hour. I could see through the silk distinctly, and, as the level of the sand was only one inch and a half from the top of the pot, I was enabled to fix my magnifier at the right focus for observing every movement of the spider, which next walked to the lower end and commenced biting the sand, taking one—two—ten mouthfuls; then, turning round, it proceeded to the other end, when I saw it had a load of sand between its falcæ, each grain of which it most deftly guided (I might almost say *handled*) with its fangs, literally pushing the grains through the sides of the tube, the silk of which was evidently adhesive, or else some viscid fluid was ejected on to the sand. After exhausting its supply it reversed its position, returned to the bottom, repeated the action of biting the sand, turned round again with its load, and distributed each grain in the most methodical manner. Occasionally, after unloading, it would put its fangs through the side and *take hold* of some grain of sand on the outside, placing it in the desired position; then, withdrawing them, reversed its position, bringing its spinners into action, strengthening the walls with another layer of silk. I watched it for just one hour and a half, at the end of which time it had completely covered the silken tube with sand, every grain of which it brought up between its falcæ from the surface of the ground. I continued to watch, but could only see the sand pushed through, and occasionally one fang, or both, adjusting the grains.

The next morning a small quantity of sand had been forced out at the top end, showing that the industrious little inmate had continued its labour during the night by excavating into the sand, and this it continued to do during the greater part of the day. The following night it had lengthened the aërial portion of the tube, covering

it with sand. While this one was engaged making its tube some of the others were still walking about, and, coming close to the tube, the builder immediately stopped work, and the loafers their walk for a moment; then they quietly shelved off in another direction, but *never* once crossed the tube, for, though they are peaceable enough when roaming about together, directly they have made anything like a tube for themselves they appear to lose their family affection, and, I regret to say, show fight if molested.

During the following night all the young spiders had disappeared, and in the course of a few days I noticed a large number of tiny tubes around the angle of the pot, while others had attached theirs to some bits of loose moss.

Since the above observations were made I have read, in 'Annals and Magazine of Natural History' for 1876 (vol. viii., p. 241), an account, by Rev. O. P. Cambridge, of an *Atypus* which he watched making a new nest. The only thing I did not observe which he mentions was that, after the spider had placed the earth against the sides, it *patted* it all over with its feet. No doubt the young one's feet were too small and tender.

Considering that there are in each family tube from 100 to 150 individuals, we might reasonably expect to meet with this grand spider in far greater abundance; but I do not hesitate in saying that as they emerge from the tubes on a bright sunny day great numbers of them are destroyed by the ants which swarm about the various colonies.

On March 30th, whilst watching the young *Atypi* emerge from the five tubes, I noticed an ant with a spider *in its jaws*; "to keep the balance true," on the other side of the tube was an impudent-looking crab-spider, *Xysticus thomisus*, with an *ant* in *its* jaws.

We must now suppose an interval of three or four years, and probably *more*, elapses between the last and the next act which I am able to go on with, for I cannot give any proof as to the time *Atypus* takes to reach *maturity*; I believe it is at least four years. I hope I shall not be considered ungallant by describing the habits (so far as I am able) of the male first; but, as the female is certainly the most interesting (though not the handsomest) of the two, I shall endeavour to let her have the last word.

As previously stated, I captured my first male October 20th, 1877, in the nest of the female. I searched a great many times during 1878 for the immature male, which I firmly believed lived in a tube just the same as the female.

On Oct. 19th, 1878, I examined nearly one hundred tubes, digging up suspicious-looking ones, resetting them if not wanted. One protruding from the bank an inch and a half caught my eye, as looking more delicately made than the others, besides having an opening at the top, with the edges *turned outwards*, showing something had escaped. I dug it up with great difficulty, as it was a very delicate one, though not more than four inches long (example). It was, as I expected, empty. I boxed it very carefully, together with the loose *débris* at the bottom of the tube: this I most carefully examined under my microscope, and at last found two immature palpi (example), proving that the tube had been occupied by an immature male. On Oct. 23rd I dug up two tubes, similar to the above, the edges of the hole turned outwards, and in each tube I found a pair of immature palpi. I find in my note-book the following:—"I think this proves that the male does either make or *steal* a tube, wherein to come of age. Try digging small tubes." Subsequent experience leads me to think the idea of an immature male turning a female out *quite impossible*.

My next advance was made Sept. 13th, 1881, when I found four males at the bottom of the tubes of the female, and one male *alone*. This I boxed, together with the tube and *débris*, among which I found the two immature palpi. This certainly strengthened my case, but it was not until July 6th, 1883, at Woking, that I dug eighteen small tubes, about four inches long (examples), from a bank covered three or four inches deep with pine-needles. I examined each occupant under my microscope; one of them was of a much lighter colour than the others, and when I did manage to get the palpi into the field, at last I saw the immature male before me. After thoroughly satisfying myself I directed his footsteps towards the open end of the tube, which I had stretched wide: he soon disappeared. I reset this one in a flower-pot, examined it from day to day until July 17th, when I perceived an unpleasant

smell from the tube, dug it up, and found the spider dead, its abdomen putrid.

July 7th, 1884, just a year after, I dug up two tubes (example), which I felt sure, from their resemblance to the others, were males; and so they proved to be, each containing an immature male. These I reset in a small bell-glass, making the holes close to the side, to enable me to watch their movements. Both soon made themselves at home by carrying their tubes up an inch from the surface, attaching the end to the glass. A short time after one died; the other lived happy and contented for some time.

On Oct. 8th I examined the tube, at 10 p.m.; all quiet. The following morning, at 9 a.m., there was the *mature* male walking about, having emerged during the *night*. I noticed that this spider, as it walked round and round, left a silken thread behind; but others, which had been living for some time in the tube with the female, and then escaped, did not in their wandering leave any such thread.

Although I have searched in every nook and corner, among dead grass, &c., in close proximity to the tubes of the females, I have never yet been so fortunate as to capture a *wandering* male, though I have since my first capture, Oct. 20th, 1877, obtained twenty-five mature males, *all* of which I found in the tubes of the females. I therefore conclude that it is the habit of the male to emerge from its tube *at night*.

Beside the above number I found seven mature males in their *own* tubes, and from these I obtained the following facts:—

On Oct. 9th, in the evening, I placed a male in a large flower-pot filled with sand to within one inch and a half of the rim: in the centre was a large tube containing a female, placed there the previous day. Next morning (Oct. 10th), on removing the cover, the male was not to be seen, but a newly-mended rent at one side of the tube showed where he had gone.

Oct. 15th, 1883, in the morning, I found a male in its own tube (example), and, among the *débris*, almost a perfect skin and part of another. I also dug several tubes containing females, which I disturbed as little as possible. In the afternoon I reset one of them in a 12 in. bell-glass, the aerial portion of the tube lying flat

on the surface of the sand, the end just reaching to the side. I then turned out the male at the opposite side, and he, spreading his legs, walked rapidly away, keeping close to the side, until he set his foot upon the collapsed tube of the female, when he stopped suddenly; the next moment he commenced making an opening in the tube, using his fangs for the purpose of tearing an opening. After each effort he paused to tap with his palpi; after doing this seven or eight times he made a rent right through both sides, and, walking through, he came out at the other side, evidently much to his surprise. I then, with my pliers, picked the end of the tube up, and, as the male came round again, hung it in his pathway, with the result that, coming into contact with it, he stopped as before, commenced to serenade with his palpi, followed by an attempt to force an entrance, more tapping in the short intervals, until at last he tore an opening in the tube, and immediately thrust his palpi and falces through, another tap, and I suppose he concluded he was accepted, for he quickly disappeared down the tube and out of sight. Next morning the rent was neatly repaired. I did not see anything more of the male until July 16th, 1884, when I noticed the skin lying at the end of the tube, pretty good evidence that, after living happily for nine months, he had fallen a victim to the appetite of his partner.

On October 3rd, 1884, I placed a male in a pot of sand; then, taking a tube containing a female, I dangled it over the pot, so that the aerial end just touched the sand at one side. The male was then at the opposite side: I gently roused him to activity, and he fairly ran round the pot until he touched the suspended tube, and there he stopped, as if paralysed; but only for a moment, as if to collect his thoughts. He then tapped, and evidently this has some great charm in it for the female. I have tried the same with my finger, but with quite a different result, in the shape of a very sharp reminder that I had better go away. The tapping was followed by attempts to tear an opening. I then interfered, driving him off, which he resented by making most ferocious bites at my pliers. I then set the tube in another pot, and turned the male in. On examining, at 10.15 p.m., I caught the male serenading, so watched him, and in less than five minutes he had torn an

opening and disappeared: the rent all closed up by next morning. This male managed to escape with his life Dec. 24th, 1884.

On July 7th, 1884, I dug up three immense tubes containing females, one a forked tube; this I examined in the evening, and was surprised to find a magnificent male in, too; no doubt they had been living together since October, 1883. I reset this tube, but have not seen anything of the male since, so conclude his old skin was too valuable to part with.

The male reared Oct. 9th, 1884, I placed in a large pot, nearly filled with sand, over which I spread some loose moss. From the thickness and width of the silken carpet I should imagine the spider had been walking round and round all night. It had made a very flimsy horizontal tube, about an inch and a half long, among the moss (examples), in which it hid during the daytime, coming out at dusk to resume its journey round the pot. I generally found it had constructed a very frail covering, I suppose at the approach of daylight. It came out nearly every night until January 17th, 1885, when I found it dead.

Another of the males found in its own tube lived in good health for two months, when one morning, at 9 a.m., I found it almost dead, its abdomen dry and shrivelled up. I gave him a good shower-bath from a fine rose water-pot, and at 2 p.m. the abdomen was fully distended, and the spider as active and as savage as ever he had been—at 9 p.m. going his rounds—and lived some time after.

Although I offered flies to these wandering males, not one would accept my hospitality; a cold shower-bath seemed to do them more good than anything else. From the ease with which the males can climb I believe that most of them find their way to the tubes of the females the same night as they emerge from their tubes, as they are always in close proximity to those of the females; some marvellous power leading them to the tubes of mature females.

I have tried putting males in pots which contain impregnated females, with the result that, instead of the sudden stop on coming into contact with the tube, they immediately run away as fast as possible.

I think I have gone through all my notes respecting

the male, and must now leave the female and the most interesting part of their history, *viz.*, that of their food,—what it is, and how they obtain it,—to our next meeting, when I hope to finish the life-history.

We now come to the problem, which is the most important to the welfare of humanity, whether in times of peace or war, and no doubt at the present time,—the question of the food-supply,—is troubling some of the highest as well as the lowest, and I venture to think that, in some respects, the humble *Atypi* are the best off. They certainly are a most contented family, always adapting themselves to circumstances.

Before giving my own observations respecting the food of this spider, I will refer to what has already been recorded. First, I find, in 'The Zoologist,' Mr. Newman gives an account of the first capture of *Atypus* in England by Mr. Brown, in which is the following:—"On drawing out *one* of the sacs I observed a *worm* at the lower end, partially within the sac and partially outside, and that the spider had evidently been eating a considerable portion of its anterior extremity. It is not unlikely that this kind of food may frequently fall to the lot of the spider."* Mr. Brown adds, "I never saw any flies or fragments of insects in the nests."

From this I should imagine the nests were broken, for at the bottom of all tubes I have dug is a trodden floor of earth, upon which, and mixed with bits of roots, I find the *débris* of all sorts of insects. Mr. Meade, in answer to Mr. Newman, says:—"I cannot help thinking it was a fortuitous circumstance, that an earth-worm was found in the retreat of the *Atypus*, though it is quite possible the spider would feed upon the earth-worm when it came in its way. I believe these spiders are erratic in their habits, and none of them bring home prey to their retreats."

Mons. E. Simon† (of Paris) considers that the food of this spider consists almost *entirely* of earth-worms. Possibly the French representative may, for there is no accounting for tastes; and such food is certainly in

* See 'Zoologist,' vol. xiv., 1856, p. 5021, "Notes on *Atypus*," by E. Newman.

† Ann. Soc. Ent. de France, 5e ser., tom. iii., 1873, p. 109.

keeping with the slugs and snails, &c., which our neighbours are so fond of. The dimensions of the tube of this spider, as given by Mons. Simon, being totally different to our representative,—and also the fact mentioned that the tubes are found “concealed by stones or in moss, which one must remove carefully, and in large masses, in order to detect them,”—lead me to think that one or the other is wrongly named *piceus*. I should much like to know in what way Mons. Simon “frequently surprised *Atypus* in the act of holding earth-worms in their falces.” I presume the nest must first have been dug up, and, if so, I cannot understand how the spider would retain its hold after the tube has been torn open, which must have been done before the spider could be *seen*.

My own humble opinion concerning worms as the food of *Atypus* entirely agrees with that of Mr. Meade,—that if a worm in its boring pushes against the lower wall of the chamber, where the lining is very thin, the spider seizes it by its head and holds on tight; the worm, finding it cannot go back again, withdraws its body from its burrow, and, falling to the bottom of the nest, it twists and twirls about, a liberty the spider resents by making rapid bites at it, soon reducing it to mince-meat.

April 9th, 1879, I dug up a large tube, which had a small opening at the *top*, the earth rammed hard on the floor or lower end of the tube. On tearing the tube open I found a worm three inches long, nearly bitten in two at half an inch from its head. It had also two minute punctured wounds at an eighth of an inch from the tip, plainly showing that the spider had pinned it as soon as it touched the ærial portion.

On February 4th, 1884, one of my garden colony had ejected a piece of an earth-worm.

These are the *only* instances respecting worms which have come under my own observation.

From the numerous examinations I have made of the *débris* taken from the bottom and around the end of various tubes, I long ago came to the conclusion that *insects* form the staple food of *Atypus*. During April and May I have observed the ejected *débris* to consist of several species of *Andrena* and *Nomada*, with a few *Cicindela*; then, later on, various *Muscidæ*; finishing

up, in August and September, with earwigs, flavoured with a few woodlice.

Having mentioned a few of the delicacies which form the food of the spider, the next important question, and one which hitherto has not been answered, is—How does the spider obtain its food?

The Rev. O. P. Cambridge, in his ‘Spiders of Dorset,’* writes:—“The young of *Atypus piceus* live with their mother in their tubular abode for a considerable time after they are hatched, coming out at times for air and exercise, and fed by insects brought into the tube by their parent. At least so I conclude, from having found the *débris* of beetles and earwigs in the tube along with the young brood of spiders.”

I venture to *entirely* disagree with this. I do not think the young *ever* return to the maternal abode after making their exit in April; neither do I think it possible for the female spider to leave and return to the tube loaded with food for its young. We have but to look at the form of its body and legs to see at once how unadapted they are for walking even on a level surface, much less up a steep bank. My opinion is that the female *never* quits its tube; certainly not in search of food; but if a large stone or other hard substance should prevent its downward boring, it might, possibly, under such circumstances, leave its nest.† I have tried running a stick in a diagonal direction towards the end of the tube, and so compelling the occupant to quit, which it did, forcing the aërial end open, always falling headlong down the bank, seemingly unable to

* ‘Spiders of Dorset,’ by Rev. O. P. Cambridge. See p. xxxiii of Introduction.

† But even under such circumstances the spider shows very great reluctance to leave the original tube. On October 15th, 1883, I found one, three inches long, containing a mature female, in a bank having but a shallow depth of soil below it the hard yellow sandstone, into which the spider had bored. I had to cut a solid piece off to enable me to lift the tube out of the hole. (*Example*.)—Whenever I have compelled a female to quit her tube, she has always left her siken threads behind; and I think that if she was in the habit of leaving her tube to go marketing (as some conclude she does), she certainly would not venture out in the dark without leaving her cord behind. But though I have examined numbers of tubes, the first thing in the morning before the dew is off either the grass or *other* spider’s webs, I have never met with any such unmistakeable proof in connection with *Atypus*.

obtain a hold, it afterwards formed a tunnel along the bottom of the bank, excavating the following night. When examining the aerial portion of the tubes I noticed a number of small patches, which appeared to be newly-mended holes or rents, exactly the same as those made by the male, and repaired by the female. I also noticed punctured holes, about the size of a pin; these were generally of one size in a large tube. I compared these with the "gape" of a female spider, and found they agreed pretty nearly. I have often put a large female *Atypus* in a shallow lid of a tin box, then teased her, until she threw back her falcies, opening them wide, and literally erecting her long fangs (example), then closing them instantaneously, at the same time making a slight forward movement. I tried this experiment, *once* with my finger, into which she drove her long fangs with such force, followed up with a terrific clenching movement, that, on withdrawing, the blood flowed freely from each puncture. This experiment led me to think that these long fangs were used in penetrating the aerial portion, and aiding in obtaining its food, the spider lying in ambush, either in or close to the aerial portion of the tube. With this idea I determined to watch my captives.

On January 6th, 1879, at 10 p.m., with the aid of a dark lantern, I examined three tubes, dug up and reset in separate pots of sand:—

No. 1 had constructed a beautiful aerial part, attaching the end to the inside of the pot.

No. 2. The aerial part was an inch long, lying horizontally on the surface of the sand.

No. 3, had brought her tube just above the level of the sand.

On teasing No. 2 with a small dry twig, the spider came up (at least so I imagined from a slight movement noticed), and on repeating the gentle scratching the tube was suddenly drawn down a quarter of an inch. The spider had evidently pulled the sides in, leaving about three-sixteenths of an inch space on each side. I made a note, as follows:—"Does the spider pull the tube in, so making a sort of pit-fall at each side, into which beetles, &c., might fall, and in their endeavour to escape attract the attention of the spider, which might then inflate the tube, and so hold the insect?"

I afterwards teased No. 3 (with the short tube). The fangs were immediately thrust through, bent over, followed by a sudden pull,—just the movement given to my finger; then were quickly drawn in again. I longed for a fly, to see if I could tempt the spider to give me proof of the method of feeding; and, as fortune would have it, I found a *Trypeta* in one of my breeding-boxes. Holding it by the wings with my pliers, I let it just scratch the end of the tube of No. 3, when almost immediately it was pierced through by the cruel fangs of the spider within. Wishing to see if it was held, I gave the fly a gentle pull, and so did the spider; and I saw the fly pulled right through the roof or side of the aerial portion of the tube down to the lower regions. I left them at 11.15 p.m., and the next morning the rent was neatly repaired.

April 25th, 1879, I tried teasing No. 1, and the instant I touched the tube the end of the twig was seized, and so suddenly that I drew it back as quickly, and with it the huge female *Atypus*, which had driven its fangs into the twig. I managed to get it down its tube again, and an hour after the rent was mended. I broke it open again, hoping to catch her mending, but she was not near. I found the rent again repaired in less than an hour.

From the above experiments, I felt tolerably certain as to how the food is obtained by these spiders. From some cause or other my captives did not do at all well, though I tried all sorts of places to make them comfortable, and for the next two years I did not make much progress.

On removing to Woking in June, 1882, I commenced working the country lanes and commons, expecting to find *Atypus*, and on April 12th, 1883, I discovered a very large colony on the banks at each side of a road, from which I removed a number of tubes to my garden-bank, where they soon settled down, making the aerial part about $1\frac{1}{2}$ to 2 inches long.

On July 16th, 1883, I held a large blow-fly by its wings, letting it crawl up the bank until it walked upon one of the tubes. The spider evidently came up a short distance, and went back. I then took a firmer hold of the fly, and rubbed its head against the tube. I soon saw signs of something coming up. I continued the rubbing,

the tube quietly and almost imperceptibly becoming distended, the spider evidently making some sort of move which I could not then make out; and there was no time for reflection, for after a moment's pause the fangs were thrust right through the fly, followed by a crunching sound as the spider closed and almost crossed the tip of the fangs around its prey. I let go with my pliers and watched; the left-hand fang was withdrawn *just* into the tube, which was immediately torn, the fang refixed into the fly; the right fang was then withdrawn, and quickly seized the fly through the opening made; then the spider commenced to give several tugs, until it had pulled the fly right through, backing down the tube with it fast in its falces, leaving a rent a quarter of an inch long by three-sixteenths of an inch wide. After an interval of three minutes I saw the tube move, and up came the spider, moving *very* cautiously towards the rent, on reaching which she opened her falces and literally *taking hold* of the rough edges, drew them towards each other in the most marvellous manner until almost close together; she then backed a little, and turned right round, bringing her spinners to the edge at one side; she seemed to be able to use these spinners with as much ease as we do our fingers; taking hold of one edge she pulled it almost close to the other, then making some seven or eight zigzag movements with the spinners she completely closed the rent, leaving it most neatly repaired. The spider then returned to feast upon the blow-fly, which she had no doubt hung up in her delightfully cool larder at the bottom of her tube.

The next morning the rent was covered with sand so carefully that I could scarcely detect where it had been.

Since this experiment I have frequently teased the tube with the tip of my finger, and had very narrow escapes of being transfixied. At other times the tube would be drawn in, in such a determined manner that I quite understood the movement to mean, "I don't want anything more." I have known a spider to retain her hold upon the tube in this manner for several hours.

July 23rd, 1883.—I repeated the trial upon the same tube with a blow-fly, and with exactly the same results. I also tried another large tube, the spider striking so quickly that it clipped off the head of the fly in the neatest manner possible, besides scratching my finger.

It soon pulled the head through and down the tube. I then immediately placed the trunk of the fly at the rent; the spider coming up to mend at once seized and dragged it down.

Immediately after this I caught a large *Sarcophaga*; holding it to the open rent, it was seized at once, and, being a strong and lively fly, it gave the spider a great deal of trouble; but after pulling, pushing, and jerking for twenty minutes, she managed to pull it through. Before she had time to return I had another fly ready at the opening, towards which she drew near, and, taking in the situation at a glance, she immediately pulled the tube in with the unmistakeable "I don't want any more" movement.

On March 19th, 1884, the warm sun shining full on to my garden-bank, I took my stand just where I had some dozen tubes in my field of vision, watching them in the hope of seeing some *voluntary* attempt to obtain food. After watching for over an hour, suddenly I saw a pair of fangs dart through one of the tubes and then as quickly withdrawn. I immediately got my magnifier to bear upon this one, and not a moment too soon, for once more the fangs darted through, paused for a moment, then back again, leaving four tiny punctures in the somewhat hard winter covering of the tube. I looked for the cause of this movement, and discovered just at one side of the tube a small hard-coated beetle on its back, which, in its endeavours to right itself, had kicked against the spider's tube. I observed, too, that when the fangs were darted through, the *tips* were pointing *upwards*. I immediately caught a fly, holding it head *downwards* in such a position that I could see the fangs; it was seized in a moment, and pulled through and down in a most business-like manner; the rent mended in less than five minutes, and I did not see the fangs as I desired.

At 12.25 of the same date (March 19th, 1884) I caught a large male *Anthophora*, and, holding it by its wings, allowed it to touch a tube hanging *down* the bank; the bee buzzed a little, and the spider immediately pulled the tube in and held it for some time. I then held the bee to a tube, the occupant of which had but a short time before taken a large fly. The bee was seized in a moment, but from *behind*. I released my hold, and it struggled and buzzed loudly, but all to no purpose – the

spider held on. In a quarter of an hour it had turned the bee completely round, now holding it by its head. After ten minutes' hard tugging, the spider pulled it through and down, a very large rent $\frac{3}{8}$ in. by $\frac{1}{4}$ in. having been made in the tube. In five minutes the spider returned, and commenced pulling the torn edges together until they almost touched; it then retired for twenty minutes. At 1.25 it returned, reversed its position, spun a few threads across the rent, and then once more retired, this time for close upon an hour, when it came up and finished mending the rent, leaving it perfectly joined—just two hours after the *Anthophora* was seized.

I caught another *Anthophora*, and held it to a tube which had not been opened since October, 1883, a very hard and dry one, protruding about two inches from the bank. The moment the bee set foot upon it, it was seized from behind and underneath. A quarter of an hour the spider was trying to reverse the bee, for it seemed to know it could not draw the bee down tail first. I was called away for twenty-five minutes, but on my return I found the bee had disappeared and the rent had been repaired. Six days after, I noticed the spider had ejected the dry and mutilated remains of the *Anthophora*. One large *Atypus* seized and dragged down two large blow-flies in ten minutes.

July 13th, 1884.—At 10 a.m. I offered a *Stomoxys* to the immature male *Atypus*, whose tube was attached to the side of a bell-glass for about $1\frac{1}{2}$ in. high. I placed the glass so that the sun shone on to the tube, then taking the *Stomoxys* by the wings I allowed it to touch the tube, and, having previously arranged my magnifier, I could see through the aerial part of the tube. Directly the fly moved, up came the spider with a rapid but stealthy step, until it was exactly under the fly, then throwing its head back it opened its falcies as wide as possible, the fangs being almost at right angles to the upright tube; a moment's pause, just like a cat about to spring upon a bird, then a lightning-like thrust, driving the fangs through and just over the thorax of the fly, closing them with a crunch; then backing, it pulled the fly through and down, but did not repair the rent until the following night.

I then tried one with a worm, which was seized, the worm struggling so hard that it pulled itself in two, the

head end crawling down at the side of the tube; the tail end held for some time, until I gave it a gentle pull, when it was released immediately. I held another worm a dozen times each at various tubes; one spider came up, and, just when I expected it to strike, it backed and pulled the tube in deep. Another struck four times and quickly relaxed its hold, refusing to take it in. The other did the same—not *one* would retain their hold after apparently tasting the worm. I made a hole in one tube and forced the worm to crawl down; a few days after the mutilated remains were lying outside.

On September 1st, 1884, a blow-fly which I put to a tube was seized by its ovipositor and one leg, and before any attempt was made to pull it in the spider *reversed* it.

On September 7th I offered drone and blow-flies, *all* of which were seized from behind, and in *every* case reversed before being dragged down the tube.

On September 25th I teased a large tube in No. 2 colony; it moved a little. I then placed my finger just above the subterranean part, then, continuing to tease the end with a piece of twig, it was seized; down went my finger, imprisoning the spider in the aerial part, which I tore open, and was amazed to find an immense mature male. After boxing him I drew up the tube, finding the female at the bottom. This is the *only* time I have ever found the male nearest the *top* of the tube. In every other instance he has invariably been at the extreme lower end, the female above.

I had noticed that all the flies offered to *hanging* tubes had been seized from behind; this I could not quite understand, but on thinking over the subject I fancied the spider might be in the *habit* of striking underneath. I immediately obtained a supply of flies; taking one I held it in the same way as before, by its wings, the head up, and allowing it to walk up the bank until it stepped upon a tube *hanging down*, with the result that the fangs were driven in from behind. I then carefully examined and found the tips were pointing up and towards the commencement of the aerial portion, showing that the spider was then head downwards, *on its back*!

I repeated this experiment upon every tube *hanging down*, and in *every* case with the same result. I then tried upon the tubes in the upright or normal position, having the end attached to grass-stems, &c. Holding

the fly in the same position, by the wings, I allowed it to crawl up and touch the tube; here the spider struck from *above* and *down*, and as there was no need for reversing the fly it was pulled in and down in much less time.

I next tried upon a *horizontal* tube; the spider moved along until it was evidently under the fly, when from the movement it turned over on its back exactly like a shark, not suddenly, but a stealthy screwing movement, until it was just beyond the fly; then striking like lightning, it buried its fangs in the fly.

Although I did not require further proof, I tried another experiment upon a horizontal tube by enticing the spider almost to the extreme end, then placing the fly nearer the subterranean part. By the movement of the tube I saw that the spider had turned back. I kept the fly moving until it was suddenly seized, the fangs now pointing *up* and towards the end, away from the subterranean part. Although the fly was half between the spider and its quiet resting-place, it was quite equal to the apparent dilemma, for after a good deal of holding on by one fang at last it turned *itself* round, and quickly pulled the fly down.

There can be no doubt as to which is the normal position of the aerial portion of the tube. If, when a spider is put into a pot of sand, it will, after making a sort of horizontal tunnel or tube, always carry the tube up the side of the pot, and no doubt it does the same thing on the banks, attaching the ends to grass or other stems *above* it; but this frail support is soon swept down by the falling earth, the wonderful spider adapting itself to its changed position. A careful examination of the spider shows how marvellously it is formed for obtaining its food without ever leaving its tube.

I have repeatedly tried to induce *Atypus* to feed from November to the end of February, but could not succeed unless the weather was very warm; and I believe that the moisture of the bank in winter is quite sufficient to sustain life until the spiders are able to obtain their natural food (*insects*) in plenty.

When digging tubes up in search of the male, I have found various insects—in one a blow-fly, in another a woodlouse, in a third a large fly, and in one a larva of *Agrotis segetum*; all of these were apparently *fixed* to the side, a short distance from the bottom.

On the sand in the bell-glasses containing a tube of a female I had put several pupæ of *Cerura vinula*, and in the other a number of *Pygæra bucephala*. On June 21st, 1884, several *bucephala* emerged, one of which must have crawled over the spider's tube, for I found it newly mended, with a large number of scales attached, and one of the *bucephala* missing. I dug the tube up, April 20th, 1885, to look for the young, which I expected out when the small hole was made for them, and there at the bottom of the tube I found the rudimentary wings and the cornea of the eye of the missing *bucephala*! On June 26th, in the other glass, the spider had seized and killed a freshly-emerged female *vinula*, but it was too large to pull down.

I think I have now said sufficient concerning the food of *Atypus*, what it is, and how obtained. My garden colony has been an endless source of pleasure to my friends, who have been highly delighted at seeing these spiders feed.

When I commenced writing these notes, I thought I should finish the account of the habits of the female in a more pleasant manner, but my last observations prevent me doing so. The truth must be told, which is, that under certain circumstances she is a cannibal, *eating her own offspring*. When the female, by making an outlet in her tube, plainly intimates to her brood that it is time and her desire for them to go out into the world on their own account, and, if the weather should not be warm or fine enough, she closes the entrance again and massacres the lot or any remaining. As previously stated, the tubes of the five impregnated females had, on March 28th, 1885, a small round hole at the apex, and a few young emerged on March 30th; and during the following night a sharp frost occurred, causing the females to fasten up the holes, and though we had very warm weather on April 17th and after that date, the holes were not reopened in any of the five tubes.

On April 20th I dug up three tubes, and found the female the sole occupant; not a young one to be seen, but a number of empty skins, which, from their *colour*, could not, I think, have belonged to the young when *first* they moulted. Two other impregnated females made holes in their tubes, but no young escaped from these; I dug them up and found nothing but the female; these had been set in bell-glasses placed in the shade.

One of the questions asked by Mr. Moggridge is the following:—"What is the precise structure of the nest of *Atypus*, and are they always uniform in character at all seasons of the year?"*

You will see by the specimens upon the table that the nest consists of a silken tube from seven to twelve inches long, of which an inch and a half to two inches forms the aerial portion; this in the normal condition is attached to the surrounding grass-stems or any projecting stone, and generally it simply follows the slant of the bank; but it is more often found hanging down, its frail attachment being easily broken by any rolling stones. The use of this aerial portion is that it really forms the *snare* of the spider, the delicate silken lining being set in motion the instant an insect sets foot upon it, the spider frequently lying in ambush just at the top of the subterranean part.

This aerial part of the tube is not always uniform in character at all seasons of the year. From April to October it presents much the same appearance, nearly always distended, except in wet weather, when it becomes flattened to the bank. Some writers have said it regains its shape by *inflation*, but I am inclined to doubt the power of the spider to raise sufficient wind to distend a tube when flattened.

After October the aerial portion is not distended, but seems to shrink and become somewhat wrinkled; and after a heavy fall of snow or rain it is often flattened so hard to the bank that it is most difficult to see. Dry, frosty weather hardens the tube, so much so that when warm weather sets in at the end of March the spider has been unable to draw a fly through.

During the past winter all the tubes in my garden-colony have been dry and hard. The very heavy fall of snow flattened every one of those in an exposed position. No attempt was made by the spiders to "inflate" them; instead of this, as soon as the warm weather set in they started making a new aerial tube, and this leads me to speak about the *branched tubes*, several of which I sent to the Rev. O. P. Cambridge some years ago; and in an article in the 'Annals and Magazine'† for 1878 he

* 'Harvesting Ants and Trap-door Spiders' (Supplement), p. 187.

† O. P. Cambridge in Ann. & Mag. N. H., Feb., 1878, pp. 106 and 107.

writes, "I am unable to conjecture what the significance of these branched tubes may be." My own opinion is that when the aërial portion of the tube becomes flattened and fixed to the earth, the spider, being unable to "inflate" it at the return of the warm weather, immediately sets about constructing another, thus forming a forked tube. Another explanation is this:—At Hampstead the ground above and about the colony is constantly being disturbed in several ways, and frequently the aërial portion is covered or partially so, perhaps only half of it; then the spider starts a new one and often carries it up, making it longer than the buried part of the aërial.

At Woking the plan of repairing some of the roads is characteristic of the "natives" in more ways than one. In the roads where no footpath exists, with high banks at each side, the plan is to allow the sand and stones to roll down into the road until they become inconvenient, then a wise man is sent from somewhere, and armed with a shovel he proceeds to shovel the rubbish up; but not into a *cart*—that would be progressing at too great a rate; he just shovels it up and "slaps" it on to the bank again, but how long it remains there in *some* of the roads depends upon how soon after "a lover of spiders" passes that way. This method of road-mending does not improve or add to the comfort of the *Atypi* which may be in the banks, many of whose tubes are completely "slapped" over, in some cases too deep for the imprisoned spiders to dig themselves out, though I have often found that they have done so. I exhibit one which I dug out of a "cake," under which I came upon the *original* aërial portion; this had been flattened, the spider boring straight through until it reached the surface again. I reset this, and after a few days' rest the spider took to the *original* aërial portion, and never once entered (so far as I can judge) the second one, forming the *branch*. In another tube I found the aërial portion rammed full of sand (example), until at last the spider, finding it could not break an opening, started another branch.

On May 7th, 1884, I noticed a most extraordinary tube in a turf bank (example). It had no less than *five* branches protruding from the bank; the owner (a huge female) was at the bottom. This bank was at the side of a road which faced south-west, and I think it most

probable that each branch had become flattened and attached to the bank during the winters, the spider adding a new one each spring-time.

Some time ago I placed a flat piece of slate on the aerial portion of a tube, leaving a very small part visible. In a day or two the spider commenced to eject the sand, and form a new aerial portion.

In one of the examples of branched tubes you will observe the branch is at the subterranean end. I think this has been formed in consequence of some disturbance of the soil, which at Woking is exceedingly light, and it is possible that a severe blow from the shovel of the road-repairer might have driven a stone down on to the tube an inch or so from the end, flattening it in; and when the spider desired to deepen, it had no alternative but to start a branch.

Before leaving the subject of the form of the tubes, I will endeavour to answer another of the questions suggested by Mr. Moggridge,* *viz.*, "Do the young, like their relatives in the south, construct nests like those of their parents in miniature?" To this I reply that they certainly do follow the example of their parents in every way, and to quote the words of Mr. Moggridge, when referring to the nest of the *true* trap-door spiders, "I believe that the nests are, as a rule, the result of many successive enlargements, and that the nest of the infant, the tube of which is no bigger than a crow-quill, is not abandoned, but becomes that of a full-grown spider. This must require time, but how long, whether months or years, we have yet to learn."

I am afraid it *will* be many years before I am able to give much proof as to the age to which these spiders attain. As I said before, the ground at Hampstead is constantly changing from various causes, and I have had great difficulty in obtaining proof positive of the age of any one female. Though I marked some of the tubes which were in the most concealed places, yet these pegs and the tubes were constantly destroyed by the swarms of holiday-folk, who wear all the grass and everything else off the face of the earth.

I paid a visit to my old Hampstead colony on April

* 'Harvesting Ants and Trap-door Spiders' (Supplement), p. 187.

† 'Harvesting Ants and Trap-door Spiders,' p. 123.

1st, 1885, and found very few of the nests left, some of their favourite hillocks having been levelled by "The Board."

On March 12th, 1879, Mr. Cochrane, the obliging Superintendent of Finsbury Park, who had become much interested in my diggings, very kindly brought his pony-trap round to the colony, and with the help of two or three of his men cut off a prominent piece of the bank about eighteen inches square, containing several tubes of females, which I should judge were at *least* three years old. This huge lump was safely placed in a large tea-chest, and landed in my garden at Holloway, where for about a year the three or four spiders seemed to do pretty well; but, what with cats and smoke, they did not flourish as I had hoped.

On June 1st, 1882, I turned the contents out of the tea-chest, and in demolishing the earth I found one of the nests all right, the female well and savage. But in the confusion of removing to Woking she was damaged, and died in a few days. I think I shall be within limits in putting the age of *this* spider at *six* years!

Many of the tubes from the Woking colony transferred to my garden-bank April 12th, 1883, were very large ones, and evidently of good age, some of the tubes quite green with moss; all the spiders are at the present time in good health and spirits, and I have become so attached to them that I shall feel leaving them as much as anything. I hope to move them, though I fear that after living so long and drawing their supplies from my garden-bank they will not care to settle in a flower-pot.

I should imagine *Atypus* was about four years in reaching maturity, then eighteen months is taken up before the young are turned out, and how long the *female* lives after that time I have yet to learn. I have one still alive and savage which turned her family out March 16th, 1884, and, judging from the vigour with which she grasps a fly or my finger when teased, I can safely say her teeth are not failing.

I imagine many females live and *die* "old maids," though not before reaching a good age; and, comparing their nests with those of younger ones, I fancy not far short of *ten* years!

There is one point mentioned in Mr. Brown's* account

* Notes on *Atypus Sulzeri*, 'Zoologist,' vol. xiv. (1856), p. 5021.

of his captures which I should like to refer to; it is the supposed power possessed by *Atypus* to "inflate" its tube. No doubt, had Mr. Brown examined *more* tubes, in all probability he would have arrived at some other conclusion, for you will observe in his account he says, "In *one* case, on opening the box in which the nest was placed, he perceived a movement throughout the tube, as if it were being inflated; this soon subsided, but the following morning he was surprised to see the whole tube inflated, especially at the end which had lain upon the bank," &c. I have watched many times for this "inflation," but all the movement I have noticed resulted from the spider creeping along from end to end; and I believe during the night they gave a few twirls with their spinners, strengthening the tube so that it would bear its own weight, and the aërial portion, being the *strongest*, would present the most inflated appearance. But to enable me to arrive at a more satisfactory conclusion than mere supposition, I made the following experiments with some large tubes and *powerful* females:—

No. 1.—8 in. long. I laid straight out.

No. 2.—7 in. long. I laid in a bent position, at right angles.

No. 3.—10 in. long. I tied up with cotton four inches from the aërial top end, but only just tight enough to prevent the female passing from the subterranean end.

No. 4.—10 in. long. Four inches of the subterranean end was tied, the spider at the other.

No. 5.—8½ in. long. Two inches from end, the spider in the middle part.

No. 6.—8 in. long. I laid a flat piece of glass along and half-way over the edge of the tube for four inches down, so that the spider could not pass.

I flattened every part of each tube, leaving the spiders at the ends, their heads towards the contracted part of the tube. Next morning I examined each one most carefully:—

No. 1.—The spider had walked from end to end, distending the tube the whole distance.

No. 2.—Was empty, an opening at the aërial end showing the spider escaped there after traversing the length, the tube still retaining the "inflated" appearance.

- No. 3.—A *very* large tube, in which I found a male as well as a female next morning; the female had been left in the lower part of the tube from which I had not removed the ball of earth usually found at the end, and no doubt the male was just above this when I laid the tube in the box; however, the pair of them could not get up sufficient wind to “inflate” the aërial portion, though both of them were found close to the contraction, leaving the part traversed during the night well distended.
- No. 4.—Another huge female, left in the aërial part, through which she walked before dark, gently distending it as she passed along; but not any alteration in the subterranean part, which was as flat as when I left it.
- No. 5.—Where the spider was confined in about four inches of the middle part, which was distended next morning, the two ends to which she could not obtain entrance were perfectly *flat*.
- No. 6.—The spider had traversed and distended the free portion up to where the end of the piece of glass was laid on, but beyond this there were no signs of any “inflation” having taken place.

The sum total of the above experiments was, that wherever the spider had a free passage, either at the aërial, or subterranean end, or in the middle of the tube, it distended it by simply passing along; but the parts of the tubes contracted were not altered in any way whatever, *all* being perfectly flat, just as I kept them on the previous day, and I think satisfactory *proof* that the spider does not distend any part of her tube by “inflating.”

Should the day after rain has fallen be warm and bright, the aërial part nearly always presents a very much distended appearance. I attribute this to nothing else than the power given to the spider enabling it (though only a *spider*) to know when to put its snare (the aërial portion) in such a condition that the flies will alight upon it in ignorance of what it may be, and suffer accordingly.

There is just one more fact which I noticed, and then I have exhausted my notes and, I am afraid, your

patience too. On December 27th, 1884, I examined a large female *Atypus* under my microscope with a power of about 40 diameters, and just in the folds of the joint of the legs where the covering is very thin I could see most distinctly the circulation of the vital fluid, and counted twelve to thirteen beats per minute; this I observed from twenty to thirty times, my nephew confirming my observation a dozen times.

To enable me to form a correct idea of the progress made by a spider in a given time, I have filled a deep bell-glass with layers one inch deep of black, white, and yellow sand. In this will be placed some young *Atypi*, which will commence their tubes on black sand. As soon as white sand is thrown out I shall know the spider has gone down one inch in a certain time, and so on, carefully noting down date as each successive colour is reached; and in course of some years I hope to solve the only facts about which I am in doubt, *viz.*, how long it is before the male and female reach maturity, and how long the female lives.

Since putting my notes into order I have made one other observation upon the young which emerged on February 3rd, 1885. Many of them have now formed very delicate tubes, attaching the aerial portion to the sides of the pot. On April 24th I caught a small *Phalangium* (? sp.), and holding it by its legs I touched one of the tubes with it, but without any notice being taken. I tried another *upright* one; the tiny spider came up directly, striking in the same manner and with as much precision as its mother, the fangs penetrating the body of the *Phalangium*, which was drawn through and down out of sight in less than five minutes. This is the *first* meal taken by any of the brood. Next day the spider was very busy excavating, throwing out quite a quantity of sand.

In bringing my notes to a conclusion, I think I cannot do better than just recall one fact in the history of this interesting spider—that when the *first* young one emerges from the tube it takes an upward course, leaving behind it a silken cord, which is taken hold of and added to by each one as they emerge and follow on. Cannot we follow their example by adding our small amount of knowledge, and so make the pathway stronger and easier for our fellow-students who may come after us?